

Plant Document Analysis

Generated on: 2025-11-17 15:39:43

Context: You asked for extraction of information relevant to "Nozzle Load Analysis" from the supplied Atmospheric Pressure Storage Tanks specification. Below are three sections that (A) list the specification items in the document that are accepted inputs/requirements for nozzle-load evaluation per industry practice, (B) list explicit measurement/data values appearing in the document that are relevant to nozzle loads, and (C) list the client/vendor inputs called out and additional data the document says are required for a complete nozzle-load analysis. I have not inferred any values beyond what is explicitly stated in the document.

Section 1: Accepted Specifications for Evaluation of Nozzle Load Analysis

- Vendor Data Requirement (12.2.viii): "Nozzle load Analysis" is explicitly required to be submitted by the vendor during Manufacturing & site erection.
- Appendix P (Addition) heading: "Allowable External Loads on Tank Shell Openings" is mandatory for design when external piping load is specified; CONTRACTOR shall provide calculations justifying acceptability of the specified loading.
- Appendix P, P.1.1 Nozzle Loads (Addition): Table of required nozzle design loadings at the nozzle-to-shell junction (radial load, circumferential moment, longitudinal moment) for nozzle nominal sizes 3" to 24" NB; states that loadings shown apply at the nozzle to shell junction.
- Appendix P: "Nozzle loads that are higher than those listed in the table may be specified by CONSTRUCTION MANAGER where necessary to suit the piping layout. CONTRACTOR shall be responsible to confirm the acceptability of the specified external nozzle and support pad loading or advise the maximum loading acceptable for the tank design."
- Appendix P: "Loadings for nozzles greater than 24 inch NB are to be agreed between CONTRACTOR and CONSTRUCTION MANAGER."
- Appendix P / general: "CONTRACTOR shall provide calculations justifying the acceptability of the specified loading." (i.e., submit nozzle-load calculations)
- 5.7.6.1.a (Addition): "Nozzle flanges above 24" NB (except man ways) shall be as per ANSI B16.47 Series – B Type." (relevant to flange and connection geometry considered in nozzle load transfers)
- P.1.1 (table) statement: "Loadings shown in the above table, apply at the nozzle to shell junction." (explicit location of applied loads)

- Appendix O / P context: Appendix P is declared "mandatory for the design of storage-tank openings when an external piping load is specified." (i.e., nozzle load analysis required when piping loads are specified)
- Appendix B / B.7 & B.8: CONTRACTOR to specify anchor bolt loadings and concrete foundation to hold down anchor load (relevant when nozzle loads produce overturning/anchoring effects to be considered).
- Vendor Data Requirement 12.2.vi & 12.2.vii: "Design Calculations" and "Structural & support Calculations" required (implying nozzle-load analysis is to be included within these submissions as per 12.2.viii).

Section 2: Measurements Provided in Document

(Only explicit numeric values in the document that are directly relevant to nozzle-load / external-loading evaluation)

- Nozzle load table (applies at nozzle-to-shell junction):
- 2" and below: "Loads are considered negligible"
- 3" NB: Radial load = 1000 N; Circumferential moment = 200 Nm; Longitudinal moment = 200 Nm
- 4" NB: Radial = 1500 N; Circumferential moment = 300 Nm; Longitudinal moment = 300 Nm
- 6" NB: Radial = 2500 N; Circumferential moment = 700 Nm; Longitudinal moment = 700 Nm
- 8" NB: Radial = 4000 N; Circumferential moment = 1500 Nm; Longitudinal moment = 1500 Nm
- 10" NB: Radial = 5000 N; Circumferential moment = 2500 Nm; Longitudinal moment = 2500 Nm
- 12" NB: Radial = 7000 N; Circumferential moment = 4000 Nm; Longitudinal moment = 4000 Nm
- 14" NB: Radial = 9000 N; Circumferential moment = 6000 Nm; Longitudinal moment = 6000 Nm
- 16" NB: Radial = 11000 N; Circumferential moment = 8000 Nm; Longitudinal moment = 8000 Nm
- 18" NB: Radial = 13000 N; Circumferential moment = 10000 Nm; Longitudinal moment = 10000 Nm
- 20" NB: Radial = 15000 N; Circumferential moment = 13000 Nm; Longitudinal moment = 13000 Nm
- 24" NB: Radial = 20000 N; Circumferential moment = 18000 Nm; Longitudinal moment = 18000 Nm

- Nozzle flanges above 24" NB: specified standard = ANSI B16.47 Series B Type (size threshold is numeric: >24" NB).
- Minimum anchor bolt size (Appendix B and F): "Minimum size of anchor bolt shall be M33." (relevant if nozzle loads contribute to required anchorage).
- Anchoring criterion: "Anchorage shall be provided if the ratio of resisting moment to overturning moment is less than 1.5." (numeric acceptance ratio).
- Corrosion allowance for anchor bolts / straps: "A corrosion allowance of 2 mm shall be applied to the smallest cross-section of the anchor bolts or on the thickness of the anchor straps." (numeric)
- Corrosion allowance minimum for anchor chairs: "Corrosion allowance is to be a minimum of 6mm (0.25 inch)." (numeric)
- Wind design parameters (may influence external piping loads and hence nozzle loads):
- IS 875 (Part 3) parameters stated: Terrain Category = 2, Group = B; K1 = 1.08; K2 = 1.1; K3 = 1.0; Wind Speed = 50 m/s; Shape Factor = 0.7.
- Design liquid specific gravity used in tank design: "Each tank shall also be designed to store a liquid of specific gravity of 0.9." (affects hydrostatic loads interacting with nozzle loads if internal piping is present)
- Minimum distance from bottom of tank to centre line of any nozzle or manway: "shall be as per API Standard 650 for regular nozzles – table 5.6a." (table reference, numeric values not reproduced in this document)
- Minimum clearance for under-bottom fittings with annular plates: "minimum clearance of 305 mm (12 inch) plus the width of annular plate is provided between the shell and the edge of the sump or fitting." (geometric constraint relevant where a nozzle discharges to bottom)
- Automatic bleeder vents minimum per tank: "in no case shall less than two 6 in. nominal diameter vents be provided per tank." (may affect nozzle sizing/venting loads)
- Primary/secondary seal gap area limits (for floating roof seals) — included here only because rim- and roof-related nozzle/venting interfaces may factor into load path but these are not nozzle loads themselves:
- Primary accumulated area limit: 210 cm² per meter of tank diameter (10 in²/ft) and max local gap width 38 mm (1.5 in).
- Vapour-mounted accumulated area limit: 21.5 cm² per meter (1 in²/ft) and max width 12.5 mm (0.5 in).
- Secondary seal accumulated area limit: 21.5 cm² per meter (1 in²/ft) and max width 12.5 mm (0.5 in).

Section 3: Inputs and Additional Requirements from Client (explicitly stated or called out as required in the document)

- Vendor deliverable: Nozzle Load Analysis must be submitted (12.2.viii).
- CONTRACTOR responsibilities (Appendix P and related):
 - Confirm acceptability of specified external nozzle and support pad loading or advise maximum loading acceptable for the tank design.
 - Provide calculations justifying acceptability of the specified loading.
 - Where nozzle loads higher than table values are specified by CONSTRUCTION MANAGER, CONTRACTOR must assess and confirm acceptability.
- Data that must be provided on relevant tank data sheet (document statements):
 - Basic configuration, service data, design requirements and all other applicable loads will be specified on the tank data sheet (5.0 and Definitions 5.1).
 - Zone Factor, Importance Factor, Site Amplification Factor and Soil Profile are to be as stated on relevant tank data sheet (Appendix E).
 - Corrosion allowance for roof plate and structure shall be as stated in the tank data sheet (5.10.2.4 Addition).
 - CONSTRUCTION MANAGER will specify on relevant tank data sheet if roof-to-shell joint is to be frangible (5.10.2.6 Addition).
- Explicit instruction for calculations/submissions:
 - CONTRACTOR shall provide the number of bolts, bolt circle diameter, vertical projection of bolts above foundation and threaded length, and any tolerances when anchoring is required (5.12.1 Addition).
 - CONTRACTOR shall furnish nozzle-load calculations and demonstrate acceptability relative to the tank design; Appendix P is mandatory when external piping load is specified.
- Missing or not provided in the document but required (document indicates these must be provided elsewhere or on tank data sheet):
 - Specific nozzle sizes, locations (azimuth/height), orientation, neck/attachment geometry, pad dimensions and welding details (document references table 5.6a for min distances but does not list nozzle positions).
 - Specified external piping loads (if higher than table) — the document allows for these to be specified by CONSTRUCTION MANAGER; the actual values are not present in this document.
 - Detailed tank data sheet values (e.g., actual tank diameter, shell thickness, foundation stiffness/geometry, soil profile, anchor bolt pattern) — the spec states these are in the tank data sheet but does not include them here.
 - Support pad geometry and reinforcement plate sizes under concentrated loads—document requires reinforcement/bearing plates under concentrated loads but does not provide

dimensions.

- Piping support configuration and load paths (e.g., whether piping is supported independent of nozzle or loads transmitted to nozzle) — no piping layout or loads are provided in this spec.
- For nozzle loads >24" NB or non-standard cases: specific agreed values between CONTRACTOR and CONSTRUCTION MANAGER (not present).
- Weld/backing/inspection requirements directly for nozzle-to-shell junction stresses beyond the requirement to provide NDE procedures and weld procedure (12.2.xii & xiii), but no numeric acceptance criteria are given here.

Quick comparison to industry practice (informative, not inferential):

- The specification includes an explicit nozzle-load table in Appendix P (radial and bending moments) — this aligns with industry practice (API 650 Appendix P style approach) that requires nozzle loadings be defined and analyzed at the nozzle-to-shell junction. The document also requires vendor submission of nozzle load analysis and structural/ support calculations, consistent with standard practice.
- The document leaves tank-specific parameters (nozzle locations, actual piping loads, and tank data sheet numeric values) to the tank data sheet and to CONTRACTOR/CONSTRUCTION MANAGER agreement — hence the delivered nozzle-load analysis must be based on those tank data sheets and any additional piping loads specified by CONSTRUCTION MANAGER.

If you want, I can:

- Identify exactly which values you must supply (from piping/tank data) to allow a complete nozzle-load calculation (explicit checklist), or
- Draft a nozzle-load calculation checklist/template aligned with the document and API 650 Appendix P so the vendor can submit a compliant analysis.